selves unable to alter the arrangement of the apparatus by which the effects are brought about—a guiding intelligence is needed (voluntary action). Such appears to be the condition of the nervous system in the higher forms of life; and we recognise such a guiding power, although we know of its existence only by its effects on the organic mechanism; and we speak of it as the mind or soul.'" It is for those who, holding Prof. Bain's theory of volition, reject the popular hypothesis that the body is endowed with a soul, to show the flaw in Prof. Lowne's argument. In saying this, however, we by no means wish to imply that there is not much in the writings of Prof. Bain quite inconsistent with this interpretation of his doctrine. Indeed we find set out with remarkable clearness in the volume before us some of the considerations which we urged, not against Mr. Lowne's argument, but against the theory of volition on which it is founded. "There is no warrant for the assumption (we said) that any movement of the kind called voluntary is not as completely and necessarily the result of purely physical antecedents, as are the movements of the planets or the spelling out of a telegraphic message . . . Whatever may be the link of connection between consciousness and nervous action, it seems both unnecessary and irrational to assert that either the amount or the direction of any vervous discharge depends in the slightest degree on the state of consciousness that preceded or accompanies it.

Sitting in his easy chair, Mr. Brown debates with himself how much he will give to the Mill Memorial Fund. Greed, small vanity, respect for Mr. Mill, the fear of being thought shabby, and perhaps a score of other mental states come and go, and at last he writes a cheque for 5*l*. Mr. Brown was aware of the mental side of his deliberations, while the corresponding physical changes in his nervous system were hidden from his observation. Hence the easy mistake of supposing that in writing out the cheque the fingers moved in obedience to spiritual direction." This view seemed, and still seems to us, to forbid every conceivable interpretation of the proposition that movements "take their rise in feeling and are guided by intellect." It would appear, however, that what we feel to be an incongruity, does not strike Prof. Bain as such. For he also, if we understand him aright, believes the physical chain to be at all points complete and sufficient within itself. At least we find it difficult to understand the following extract from the chapter "How are Mind and Body united?" in any other sense. "From the ingress of a sensation, to the outgoing response in action, the mental succession is not for an instant dissevered from a physical succession. A new prospect bursts upon the view; there is a mental result of sensation, motion, thought, terminating in outward displays of speech or gesture. Parallel to this series is the physical series of facts, the successive agitation of the physical organs, called the eye, the retina, the optic nerve, optic centres, cerebral hemispheres, outgoing nerves, muscles, &c. While we go the round of the mental circle of sensation, emotion, and thought there is an unbroken physical circle of effects. It would be incompatible with everything we know of the cerebral actions to suppose that the physical chain ends abruptly in a physical void occupied by an immaterial substance; which immaterial substance, after working alone, imparts its results to the other edge of the physical break, and determines the active response—two shores of the material with an intervening ocean of the immaterial." Now remembering that movements of all kinds are physical facts, have their place in the "unbroken material succession," we once more put the question—In what sense can a particular class of movements be said to take their rise in the mental series which runs parallel to, without forming part of, the physical series?

The truth or meaning of our assertion that the proposition, "movements take their rise in feeling," cannot be rendered into thought, may now be perceived by anyone who will attempt to picture to themselves a state of consciousness turning on, or in any way determining the direction of, a nervous discharge. But as some of our philosophers, strong in logic, can surmount psychological impossibilities with the same ease that our divines can rise above them on the wings of faith, the disciples of Mr. Mill and Prof. Bain may demur that the question is not one of conceivableness or inconceivableness, but of proof. Well, then, let them show, if they can, that they have any better ground for the opinion that voluntary movements take their rise in feeling and are guided by intellect, than a superficial observer ignorant of the construction of the steam-engine might have for a belief that the movements of a locomotive take their rise in noise and are guided by smoke. Should it be attempted to turn the point of the foregoing argument by aid of the curious description of a mental fact, that it is a "two-sided fact"—both body and mind—our difficulty only requires to be restated. In what sense can a movement called voluntary—the objective side of a "mental fact"—take its rise in feeling the subjective side of the same "two-sided fact"? Using Prof. Bain's own words, "it is, after all, body acting upon body."

In this work Prof. Bain does not advance his idealism; probably he may have concluded, and justly, that it would prove too metaphysical for the readers of the International Scientific Series. Throughout his language is that of a realist. Mind and Matter seem to be accepted as ultimate facts; and "the institution of two distinct entities" is spoken of as "not in itself a crushing dispensation." Not only so, in such expressions as "undivided twins," "one substance, with two sets of properties, two sides, the physical and the mental—a double-faced unity," we have, to say the least, very much of the ring of Mr. Spencer's hypothesis that nervous action and consciousness are the objective and the subjective faces of his Unknowable—the one Ultimate Reality. We do not say that Prof. Bain is attempting the dangerous experiment of trying to put new wine into old bottles, but we fear until he has explained more fully the modifications which, by changes or additions, he means to make in his system, his present deliverance will be apt to suggest this.

DOUGLAS A. SPALDING

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## *THE ELEMENTS OF LOGARITHMS*

*The Elements of Logarithms.* By J. M. Peirce. (Boston, U.S.A.: Ginn Brothers, 1873.)

IN the preface Prof. Peirce writes:—"Logarithms ought not to be comprised, as they often are, in the midst of a treatise on algebra. For, in the first

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place, they are not algebraic functions; and, besides this, the student is unlikely to form an adequate comprehension of their purpose, or to appreciate the importance of acquiring skill in the use of his tables if he takes them up in the course of a study to which they have no application. If logarithms must needs be combined with any other branch of mathematics, their true alliance, on grounds both theoretical and practical, is not with algebra but with trigonometry." In point of fact, logarithms are usually included in works on trigonometry; and we can see no reason why their principle should not also be explained, as at present, in treatises on algebra, to which the theory does really belong. Ordinary students of mathematics never learn to use logarithms properly, not so much owing to deficiency of explanation in the existing works as to the fact that they never meet in the course of their reading with anything requiring such a knowledge. Prof. Peirce's work contains 82 small octavo pages, and is intended for readers possessed of only a very trifling knowledge of algebra. It is simply what a chapter on logarithms in an ordinary algebra would become if printed separately, with the addition of copious examples and an appendix on their use in trigonometry. To show how limited is the range of the book, it is only necessary to state that all the rules have reference merely to three and four figure tables, and that the natural base $e$ is not even alluded to, though it is stated that a chapter on the Napierian system will be added in another edition. There is little either to commend or blame in the book. It is partly intended for the entrance examination at Harvard, but it seems to us it would be most useful to computers who wished to obtain some notion of the reason for the rules they were in the habit of employing. In one respect the book is in advance of the time, viz., some paragraphs are devoted to the history of the subject. We believe the day will come when no scientific treatise will be considered complete that does not contain short historical notices relative to the discovery of the principal results.

Prof. Peirce defines the arithmetical complement as the complement from 10; we should much prefer to see it defined as the complement from zero, so that the arithmetical complement of a logarithm of a number should be the logarithm of the reciprocal of the number, viz. its cologarithm. We also hope the day will come when the addition of 10 to the mantissæ in our logarithmic trigonometrical canons will be abandoned, and the true negative characteristics printed and used. A complete seven-figure table with negative mantissæ was published at Paris by M. J. Dupuis in 1868, which was a step in this direction.

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## PEDIGREE AND RELATIONSHIP OF MAN

*The Story of the Earth and Man.* By J. W. Dawson, LL.D., F.R.S. (Hodder and Stoughton.)

*Man and Apes.* By St. George Mivart. (Hardwicke.)

THESE two works possess some points in common. Neither of their authors accept Darwinism in its entirety, the former absolutely rejecting it. They both treat of the relations of man to the lower animals, and both find the chasm of the human mental and moral phenomena the great drawback against bringing man into the same category with the apes. The manner in which the subject is treated, and the facts employed, are however not the same, while the results arrived at are very different, as will be seen from the following remarks.

Dr. Dawson is very much irritated by the manner in which many of the biologists of the present day, without feeling any necessity for giving the reasons for their belief, are in the habit of writing and talking as if the evolution hypothesis were fully proved, and established as a fundamental principle of nature. "That in our day a system destitute of any shadow of proof, and supported merely by vague analogies and figures of speech, and by the arbitrary and artificial coherence of its own parts, should be accepted as a philosophy, and should find able adherents to string upon its thread of hypotheses our vast and weighty stores of knowledge, is surpassingly strange,' remarks our author in a spirit which we are surprised to meet in one who thinks that "in the present state of natural science in Britain this evil (of regarding geologic facts from an evolutionary point of view) is to be remedied only by providing a wider and deeper culture for our young men." In the same dogmatic and unscientific spirit all the theoretical questions which are discussed, are written for the perusal of the readers of a popular journal, and such being the case, it is hardly surprising that false notions are so common as to the direct bearing and tendency of the greatest theory of modern times.

"We need not stop to mention the usual inaccuracies as to facts" is the way in which a criticism of a paragraph in one of Mr. Herbert Spencer's works is commenced, and as might be almost predicted from so self-satisfied an author, it is in the criticism only in which the inaccuracy is to be found. On the following leaf we are astonished to learn with reference to the Ascidian, that its "resemblance to a vertebrate animal is merely analogical, altogether temporary and belonging to the young state of the creature, without affecting its adult state or its real affinities with the mollusks." The author can hardly have studied Kowalevsky's memoir on the subject, in detail.

In his anatomical structure, man, according to Mr. Dawson's distorted view, presents differences from all the apes which are at least of ordinal importance, distinctions "mainly dependent on grade or rank, and not to be broken down by obscure resemblances of internal anatomy having no relation to this point, but to physiological features of very secondary importance." When, in association with this, we are told that it is merely begging the question to say that "the fact that the human skeleton is constructed on the same principles as that of an ape or a dog, must have some connection with a common ancestry of these animals," we think it hardly necessary to make further comment on the work in question, except to hope that it will not fall into the hands of commencing biological students, who would find it difficult to shake off the false associations that, in it, surround the facts which are discussed.

Mr. Mivart treats his subject in a very different manner. His object is "to investigate by the unimpassioned process of enumeration and weighing facts of structure, what is the teaching of Nature as to the affinities of various apes to man." In doing this, after a rapid review of the clasification of Mammalia generally, and the geographical distribution of the apes and lemurs, or half

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